

Physical Properties of Food Wraps

What We'll Study...

The mechanical properties of polymers in the form of food wraps. Properties include tensile strength, elongation, flexural strength, and impact resistance.

Did You Know...

Analytical chemistry is important to industry because the accurate measurement of quantities, composition, and properties is critical to the market success of products. These measurements are usually performed on highly sophisticated and complex instruments that are not available in the high school laboratory. This lesson contains simulations of analytical work to give you an appreciation for the technical work needed by industry. You should become familiar with the terms “accuracy” and “precision” as the work is performed. For all mechanical properties testing of polymers, a wide spread of values is obtained. Therefore, it is necessary to test several samples and calculate an average for each property.

Among the more important mechanical properties of polymers are tensile strength, elongation, flexural strength, and impact resistance. A large number of standard tests have been developed. Standards are set by the American Society for Testing Materials (ASTM).

To measure tensile strength, a test specimen of uniform cross-section is clamped at each end and stretched until it breaks. Tensile strength is defined as the stress force necessary to break the sample at a constant rate of stretching. It usually varies from about 1,000 to 12,000 pounds per square inch (psi) for most common commercial polymers. These values would be equal to 6.9 to 82.8 megapascals (MPa) or newtons/square meter (N/m²).

Elongation is the increase in length of a sample at the breaking point. Elongation is associated with the uncoiling of polymer molecules and their movement relative to other molecules. Highly crosslinked polymers have a low elongation relative to linear polymers. Elongation can vary widely among polymers and is usually expressed as a percent of the original length of the sample.

Flexural strength is measured by supporting a sample test bar of uniform cross-section at each end, in a horizontal position. The sample is then subjected to a vertical stress until it yields or breaks. Most common polymers have flexural strengths ranging from 3,000 to 20,000 psi (20.7 to 138.9 MPa or N/m²). Crosslinked polymers are more rigid and have a higher flexural strength than linear polymers.

Impact resistance is a measure of the toughness of a polymer. It can be determined by striking a vertical sample with a weighted pendulum and measuring the distance the pendulum travels after the sample breaks.

Values for impact resistance for common polymers range from 0.5 to 10 foot-pounds per inch (0.1 to 0.2 joules per square centimeter).

OBJECTIVES

To test the physical properties of various food wraps and compare polymer-based wraps to nonpolymer-based wraps.

MATERIALS (PER LAB STATION)

- 5 (2-inch x 8-inch) strips of the following food wraps:
 - polyvinylidene chloride film (e.g., Saran Wrap Brand plastic film)
 - polyethylene film (e.g., GLAD WRAP** plastic film)
 - waxed paper
 - aluminum foil
- 2 ring stands and a crossbar with 2 clamps
- 1 (10 N) spring scale
- 1 wooden handle hammer
- 1 screw eyelet with a diameter fitting a crossbar
- 1 coffee can (one end open)
- 1 (30 cm) metric ruler
- duct tape
- 1 set of weights (0.2 N to 10 N)
- 1 pair of scissors

SAFETY AND ENVIRONMENTAL CONCERNS

- Goggles should be worn.
- Dispose of materials as instructed by your teacher.

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